[10191/3813]

SUPPORT ELEMENT

Field of the Invention

The present invention relates to a support element for setting a fuel distributor line apart from a fuel injector inserted in a cylinder head of an internal combustion engine.

Background Information

A mounting device for mounting a fuel injector on an intake manifold is described, e.g., from German Patent 29 26 490. In this case, a mounting element axially fixes the fuel injector to the fuel-distributor line or to a plug nipple, the mounting element being designed as a U-shaped securing clamp having two legs which are elastic in the radial direction. In the assembled state, the securing clamp engages in matching recesses of the plug nipple and is snapped into place in a recess in a connection fitting of the fuel injector, the recess being designed as an annular groove. The axial clearance between the recesses and the securing clamp as well as between the annular groove and the securing clamp should be kept small in order to achieve precise fixation of the fuel injector without stresses on the gasket.

Particularly disadvantageous in the mounting device described in German Patent 29 26 490 is the warping effect of the various mounting elements on the fuel injector. The force magnetic flux generates in the fuel injector leads to deformations and thus to lift changes of the valve needle, and even to jamming as well as a compressive and bending load on the housing components, which usually have thin walls and are welded to each other at several points. Furthermore, any mounting measure, for example by means of a contact flange, leads to an increase in the radial expansion of the fuel

injector and thus to higher space requirements in the installation.

Summary

The support element for a fuel injector according to the present invention has the advantage over the conventional art that the fuel-distributor line is braced at the fuel injector without radial forces via the support element. As a result, no warping and subsequent damage of the fuel injector and the connection of the fuel-distributor line will occur. The support element not only transmits the holding-down force of the fuel-distributor line to the fuel injector but also provides a flexible fixation that compensates for tolerances and offsets.

It is advantageous that the support element is easy to produce by stamping from sheet metal. It may also be produced by deep-drawing and stamping.

The support element according to the present advantageously dispenses with screws or securing clamping claws for mounting the fuel injector on the front face of the cylinder head.

Punched out recesses, which are easy to produce, advantageously provide secure fixing of the support element at the fuel injector and simple bracing of the fuel-distributor line.

Various guidance variants, such as beveled components whose inclined surfaces slope radially inward, guidance by the cylinder head, or by projections engaging with each other from behind, also brace the radial forces of the support element.

Especially advantageous in this context is the contacting of the edges of the support element along the axial extension of the support element in a radially inward direction, so that the support element abuts against the fuel injector along its entire length, thereby preventing the support element from bending open.

Various tab forms may be configured in such a way that a more or less pronounced elastic and plastic deformation allows optimal bracing between the fuel-distributor line and the fuel injector under the given installation situation.

Brief Description of the Drawings

Figure 1A shows an exploded, schematic, part-sectional view of an exemplary embodiment of a fuel injector able to be combined with a support element configureaccording to the present invention, prior to mounting.

Figure 1B shows a schematic, part-sectional view of the exemplary embodiment shown in Figure 1A, in the mounted state.

Figure 1C shows a plan view of the exemplary embodiment of the support element configured according to the present invention, shown in Figures 1A and 1B.

Figures 2A - 2D show four example embodiments of support elements configured to be free of radial forces.

Figures 3A - 3C show three different views of a fifth example embodiment of a support element free of radial forces.

Figure 4 shows a sixth exemplary embodiment of a support element free of radial forces.

Figures 5A - 5C show three different views of a seventh example embodiment of a support element free of radial forces.

Detailed Description

Figures 1A through 1C show schematized part-sections through an exemplary embodiment of a fuel injector 1, a fuel-distributor line 2, and a support element 3 which is configured according to the present invention and to be mounted in-between, shown in a view before (Fig. 1A) and after (Fig. 1B) mounting of said components.

In this context, a fuel injector 1 is designed in the form of a direct-injection fuel injector 1, which may be installed in a valve seat of a cylinder head for the direct injection of fuel into a combustion chamber of a mixture-compressing internal combustion engine having externally supplied ignition (not shown further). The valve seat may also be provided at a connecting piece of an intake manifold (not shown). At an inflow-side end, fuel injector 1 is provided with a plug connection to a connecting piece of fuel-distributor line 2, which is sealed by a gasket 5 between fuel distributor line 2 and a supply nipple 6 of fuel injector 1. Fuel injector 1 has an electrical connection 7 for the electrical contacting to actuate fuel injector 1.

Support element 3 according to the present invention is provided to space fuel injector 1 and fuel-distributor line 2 apart from one another in a manner that is free of radial forces. Support element 3 is made up of a clamp 8, which is braced against a shoulder 9 of fuel injector 1 on one side and against a shoulder 10 of fuel-distributor line 2 on the other side. For easier mounting, clamp 8 has a slot in the region of electrical connection 7 of fuel injector 1.

It may be gathered from Figure 1C that the first exemplary embodiment of a support element 3 configured according to the present invention has a round cross-section. Alternative forms are shown in Figures 3C and 4.

Two tabs 11 are connected to clamp 8 and provide flexible bracing of fuel-distributor line 2 with respect to fuel injector 1. A detailed representation of clamp 8 may be gathered from the views in Figures 3A through 3C, 4 and 5A through 5C, as well as from the following description.

Figures 2A through 2D show schematic, part-sectional views of portions of the fuel-injection system shown in Figures 1A and 1B, in the region of connection nipple 6 of fuel injector 1 and fuel-distributor line 2.

Figures 2A through 2D represent various example embodiments of bracing the radial forces between support element 3 and fuel injector 1 in the case of support elements 3 having a round design.

Figure 2A shows a first, least complicated embodiment in which support element 3 is guided by a guide element 12, which may be the cylinder head, for example, in such a way that a radial displacement of support element 3 in response to the pressure exerted by fuel-distributor line 2 is impossible.

A similar possibility is offered by a keyed connection, as shown in Figure 2B. In this case, support element 3 is provided with an at least partially circumferential groove 13, which, together with a projection 14 formed at shoulder 9 of fuel injector 1, ensures, by mutual engagement, that tabs 11 of support element 3 do not shift radially.

A beveling of shoulder 9 of fuel injector 1 and/or tabs 11 of support element 3 also suggests itself for the bracing of fuel injector 1 at shoulder 9 in manner that is free of radial forces. In Figure 2C, only shoulder 9 is inclined at an angle α, while in Figure 2D both shoulder 9 of fuel injector 1 and tabs 11 of support element 3 are inclined, preferably at the same α angle. This measure, too, can prevent shifting of tabs 11 under axial force. The variant of an embodiment illustrated in Figure 2C has the advantage of uncomplicated manufacturability, support element 3 being able to be adopted unchanged.

Figures 3A through 3C and 4 represent schematic views and partial sections of exemplary embodiments of a support element 3 configured according to the present invention, in the unmounted state. Equivalent components have been provided with corresponding reference numerals in all figures.

Figure 3A shows a side view of an example embodiment of a support element 3 configured according to the present invention; Figure 3B a frontal view; Figure 3C a plan view from above. Figure 4 shows a plan view from above of an example embodiment that is to be considered an alternative to Figure 3C.

Figure 3A shows support element 3 configured according to the present invention with clamp 8 and tabs 11. Tabs 11, due to their form and their extension at clamp 8, are configured in such a way that they may be deformed plastically/elastically, thereby introducing an axial force into fuel injector 1. As can be gathered from Figure 1B, clamps 11 rest against shoulder 9 of fuel injector 1.

Figure 3B shows a view of the slotted side of support element 3. In the installed state of support element 3, electrical connection 7 of fuel injector 1 lies in the region of slot 15.

Figures 3C and 4, in the same view, show two example embodiments of support element 3, viewed in the discharge direction. Support element 3 is not round on one side but has a roughly rectangular or square cross-section form in order to prevent radial shifting of support element 3 in response to the axial introduction of force by fuel-distributor line 2. Such force may lead to warping of fuel injector 1 in the cylinder head or deformations of fuel injector 1 and subsequent malfunctions, for example by jamming of the valve needle of fuel injector 1. In addition, edges 16, which form the end of clamp 8 on both sides of slot 15, are folded radially inward in the direction of fuel injector 1. This ensures that edges 16 contact fuel injector 1 along their full axial length, so that shifting of support element 3 is prevented.

The embodiment shown in Figure 4 has the advantage of simple manufacturability and a high clamping effect, whereas the exemplary embodiment illustrated in Figure 3C effectively prevents the edges from bending open.

Figures 5A through 5C show an additional exemplary embodiment of a support element 3 configured according to the present invention. It has annular tabs 11, which are connected to clamp 8. A recess 17 in annular tabs 11 provides higher elasticity of tabs 11 and thus greater tolerance with respect to axial twisting. Edges 16 may be configured as shown in Figures 3C or 4.

Due to the flexible mutual bracing of the components, it is not only possible to compensate for axial forces generated by fuel-distributor line 2, but also for manufacturing tolerances and linear deformations due to heating during operation of the internal combustion engine.

The present invention is not limited to the exemplary embodiments shown and is also applicable to fuel injectors for injection into the combustion chamber of an internal combustion engine having self-ignition.